Models

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1 Phenomenological Growth Models

1.1 Models

- Exponential growth model
$$\frac{dC}{dt} = rC_t$$
- Generalized growth model
$$\frac{dC}{dt} = rC_t^p$$
- Logistic growth model
$$\frac{dC}{dt} = rC_t(1 - \frac{C_t}{K})$$
- Generalized logistic model
$$\frac{dC}{dt} = rC_t^p\left(1 - \frac{C_t}{K}\right)$$
- Richards growth model
$$\frac{dC}{dt} = rC_t\left(1 - (\frac{C_t}{K})^a\right)$$
- Generalized Richards growth model
$$\frac{dC}{dt} = rC_t^p\left(1 - (\frac{C_t}{K})^a\right)$$

where C_t is cumulative incidence at time t, p is scaling factor of growth, K is final epidemic size.

1.2 Pseudo-code

1. SimpleGrowth function: differential equation
2. solvedSimpleGrowth function: solve differential equation to get predicted incidence
3. ResidFun function: calculate residual = predicted incidence - observed incidence
4. fittingSimpleGrowth function: fitting data to the model by minimizing sum of squared residuals (L2-norm) and obtain parameter estimates Ptrue
5. confint function: obtain uncertainty around parameter estimates, by running nsim simulations. Each simulation includes:
   (a) Obtain predicted incidence bestfit by executing solvedSimpleGrowth with parameter inputs being Ptrue
   (b) Generate simulated dataset around predicted incidence, by assuming a certain error structure (i.e., Poisson distribution, Negative Binomial distribution)
   (c) Fitting simulated dataset to the model to obtain a new set of parameters